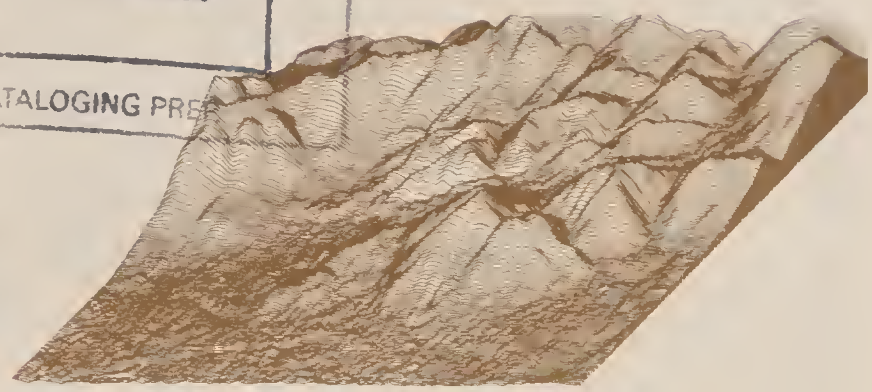

SURFACE ENVIRONMENT & MINING
SEAM
USDA FOREST SERVICE PROGRAM
145 GRAND AVE. BILLINGS, MONT. 59101
SEPTEMBER, 1979

LANDFORM: A COMPUTER-AIDED PLANNING AND DESIGN PROCESS

LANDFORM was demonstrated on this proposed phosphate mine in Idaho.

As long as humans have inhabited the earth they have been closely tied to the land. Both early man and the modern land manager have shared this common bond. However, over time, land use has become increasingly complex and methods of dealing with our land base have become more sophisticated.

Over the past few years technology has advanced significantly and methods have now been developed to collect both surface and subsurface data in digital form so that, with the aid of computers, it can be rapidly manipulated and displayed. In addition, programs and processes have been developed to use digital data for planning and designing many different types of landform changes, including those resulting from such activities as surface mining, timber harvest, transportation facilities construction and ski area development. Visual display and simulation capabilities have been developed which can be used to depict what a proposed development will look like before any land is disturbed.

LANDFORM is a computer-aided system for planning and designing. It brings together digital modeling, information display techniques, and engineering design programs into a single, integrated process. This process will help land managers, industry and the public identify the costs and benefits of a development proposal in a more timely and effective manner.

The system was developed and demonstrated under the SEAM program on a phosphate mine in Southern Idaho in cooperation with J. R. Simplot Company, Forest Service Intermountain Region and the U.S. Geological Survey.

Dick Mahan, Geometronics Engineer, brings years of experience in private industry and government to the project.

LANDFORM is a series of interrelated computer programs designed to manipulate surface and subsurface data to produce computations and a variety of plots that are useful both for land management planning and for engineering design. The accuracy of the output is directly dependent on the quality and accuracy of the input. The system is designed to show how well the terrain model represents the actual ground.

The digital terrain model, used with other programs in the system, enables the user to take physical features from a variety of sources and plot them onto maps or photographs. The programs also calculate such quantities as material to be excavated, ore volumes, or acres to be vegetated.

Some advantages of using a systematic computer-aided process are:

1. Reduction of planning and design costs.
2. Ability to examine and evaluate a greater number of alternative actions.
3. Ability to provide more comprehensive plans and designs with more satisfactory consideration of all resources.
4. Depiction and simulation of proposed actions, making them more easily visualized and understood by planners and the public.
5. Improved analysis and coordination of various development operations with resulting efficiency and reduced costs.

LANDFORM is designed to operate with Fortran language on large computers such as the Department of Agriculture Univac 1100 at Fort Collins, Colorado, as well as on minicomputer systems which would be available to most industry users.

The process is divided into three major phases.

PHASE I—DATA GATHERING AND ORGANIZATION

Digital models are built using techniques of gathering surface and subsurface data from aerial photographs, maps and geologic exploration methods. Terrain data may be gathered in several different ways.

The Mahan method involves the development of a digital terrain model from a stereo pair of aerial photographs. This is produced by digitizing individual points along drainages, ridgelines, and general form lines. Terrain models of known accuracy can be generated with a limited amount of data. The data can be collected at different levels of resolution depending on planning needs and scale of photography.

Another method involves using data collected by the U.S. Geological Survey as a by-product of the agency's orthophoto production process. This data, which is derived from 1:80,000 scale photography, is of intermediate level (40 foot contour) accuracy. This level would be suitable for planning where fine resolution is not essential and it could be a rapid and economical method of obtaining data for general land management planning.

A third method is the collection of data directly from contour maps. This can be done using the principles of the Mahan method or by digitizing along contour lines.

A stereo digitizer is used to transfer terrain information from aerial photographs to magnetic tape for computer storage, processing, and retrieval.

Other surface resource information that is separate from the terrain itself such as vegetative types, habitats, land survey lines or transportation routes may be input directly from on the ground surveys or by digitizing the data from maps or photographs.

In addition to surface data, subsurface data can be digitized from drill hole logs or by other geological exploration techniques. From this, subsurface information such as ore bodies, faults, and other geologic structures can be analyzed and displayed. Both surface and subsurface information can then be interrelated to other resource information for consideration in design.

A key requirement of any computer-aided system is its ability to store large quantities of data (the digital model) and provide an efficient means of retrieving selected portions of that data for the development of designs and displays. LANDFORM is structured so that all entering data is transformed to a uniform coordinate system. This data is then referenced so that specific information can be readily located without searching the entire data bank.

PHASE II— INFORMATION DISPLAY

The digital data is used to develop visual information on both the surface and subsurface. These surfaces can be portrayed with some basic outputs, such as contour, profile, grid, cross sections, slope and aspect plots. These outputs are particularly helpful to designers and planners for examining and analyzing various design parameters. Proposed changes and the alternative designs themselves can be plotted. This would include displaying such things as boundary lines, pit designs, transportation designs, and waste disposal areas in the perspective of vertical or oblique photographs as well as in two dimensional plots.

PHASE III— DESIGNS AND PLANS

Designs are generated by using engineering programs with the surface and subsurface digital models. The information can be used for a variety of products. Examples include, computing the quantity of overburden or waste material, defining both quantity and

Designers and planners can utlize the computer to prepare more timely and effective mine plans.

quality of mineral deposits, and generating earthworth quantities for alternative transportation facility locations. This tabular information used with the design displays is especially helpful to designers and planners and to the public for analyzing the effect of a proposal before any action is started on the ground.

TECHNOLOGY TRANSFER

In order to provide for greater understanding and use of LANDFORM to those who can benefit from it, the process has been documented in two handbooks: the User's and Operator's Manual and the Programmer's Manual. These documents are the framework for a training program that can be directed toward the Forest Service, other Federal and State Agencies, and industry personnel.

Further developments and refinements are anticipated beyond the initial release of the programs. Initial application has been oriented to supporting the decisionmaking process regarding mineral areas. As a result of an increased concern for environmental protection, and resulting legislation, careful and complete planning of mineral development has become mandatory. Comprehensive planning is especially important because mining not only requires a significant investment but also produces rapid and significant changes in the physical, biological, social, and economic structure of a community. In order to effectively deal with these changes, timely decisions are required.

LANDFORM is intended to help the land manager, whether State, Federal or private, do a better and more comprehensive job of planning for development and reclamation. The use of computer-aided systems for gathering and displaying information can lead to more informed and objective decisions on a wide range of activities involving changes in landform.

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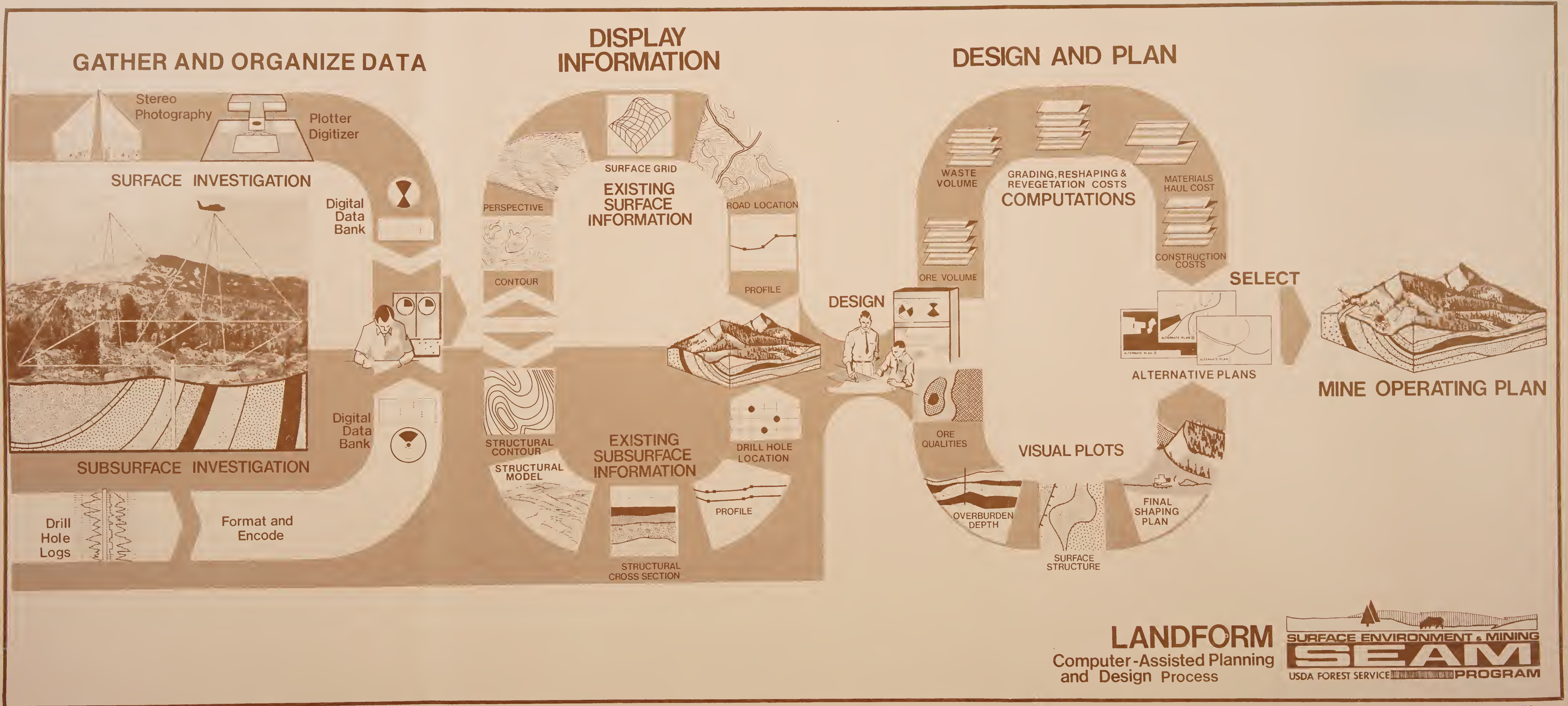

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